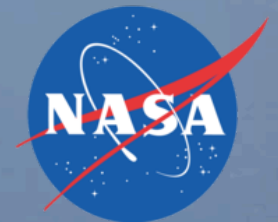


# Recent NASA Dryden COA Experience



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**April 29, 2008**





## Recent NASA Dryden COA's



- 2005 Altair NOAA Mission
  - 6 missions in NAS, up to 18.5 hrs
  - Goal: Atmospheric Science, remote sensing, mapping, wildlife monitoring, maritime surveillance demo



### 2006 Altair Western States Fire Mission

- 2 flights in NAS
- Goal: Wildfire Mapping

- 2007 Ikhana Local Area
  - > 30 flights in NAS
  - Goal: Pilot Training



### 2007 Ikhana Western States Fire Mission

- 8 flights in NAS, up to 20 hrs
- Goal: Wildfire Mapping



Altair



Altair

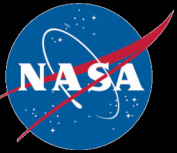


Ikhana



# ***NASA Dryden UAS Safety Process***

- Priority
  1. Protect public (ground and flying)
  2. Protect high value ground assets
  3. Protect UAS
  4. Accomplish Mission
- Detailed hazard analysis accomplished for each mission
  - Assessment of probability and severity
  - Fault tree used to estimate overall reliability
  - Analysis results in changes to system design, mission plan, contingency plans, mission rules
- Independent Range Safety Analysis
  - Statistical analysis based on vehicle reliability, route, and population density
- Airworthiness and Flight Safety Review
  - Detailed review of project objectives, vehicle modifications, flight plan, operations plan, risks, mitigations
- Tech Briefs
  - Periodic review of past flights, operations planning, configuration changes, hazards, mission rules, go/nogo



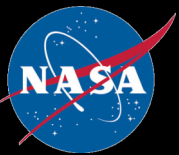
## *Typical UAS Hazards*

- Mid-air Collision
- Engine failure
- Power failure
- Aircraft flyaway
- Loss of datalink
- Network failure
- Control system failure
- Loss of ATC communication
- GCS failure
- Loss of GCS/antenna power
- Structural Failure
- Explosion/fire
- Controlled flight into terrain
- GCS evacuation
- Airdata failure
- Icing
- Landing Gear/Brake failure
- Nose camera failure

Each hazard is evaluated for

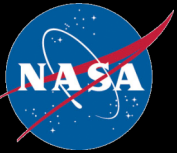
- Cause(s)
- Effect(s)
- Mitigations
- Probability
- Severity





# Range Safety Zones





# Common COA Provisions

- Navigation and strobe anti-collision lights
- Mode C transponder
- Fully operational redundant flights controls, navigation
- Chase aircraft below class A when outside segregated airspace
- 2-way radio communication with ATC
  - Telephone back-up with ground station
  - Immediate notification following lost-link
- Visual Meteorological Conditions (VMC) & clear of clouds
- Visual Observer when outside Class A or segregated airspace
- Pilot and Observer qualifications
- Reportable events
  - Deviations from special provisions
  - Lost link
  - Incidents/accidents



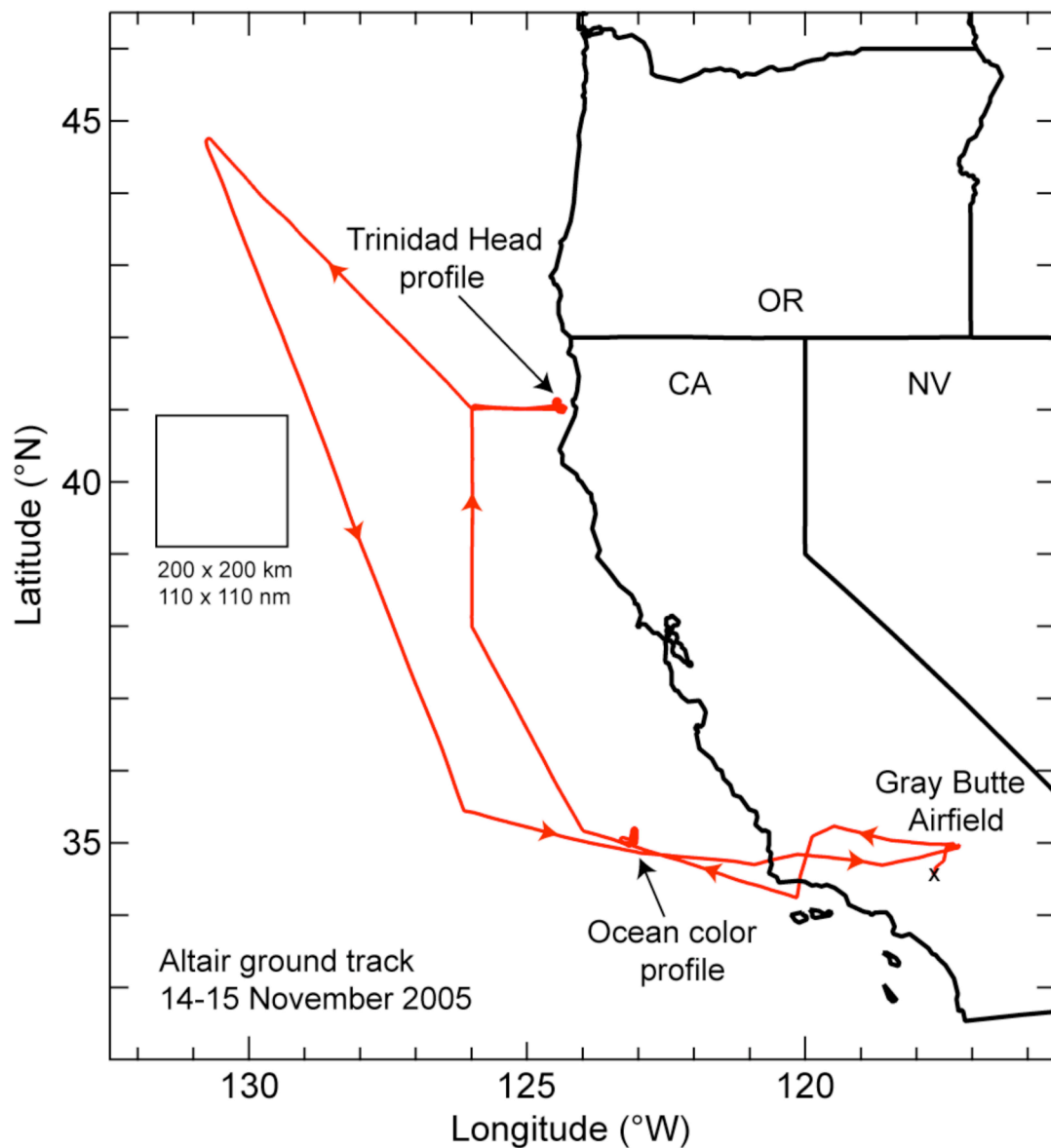
# ***UAS Lessons / Best Practices***

- Communicate early and often (face-to-face where possible)
  - FAA
    - Get Flight Safety & Air Traffic Controller Feedback
  - Segregated Airspace owners
  - Contingency landing sites
  - Frequency owners
- Contingency Planning requires significant time investment
  - Decision flow diagram
  - Predetermined landing sites
- Expect the unexpected
  - GPS jamming
  - Weather

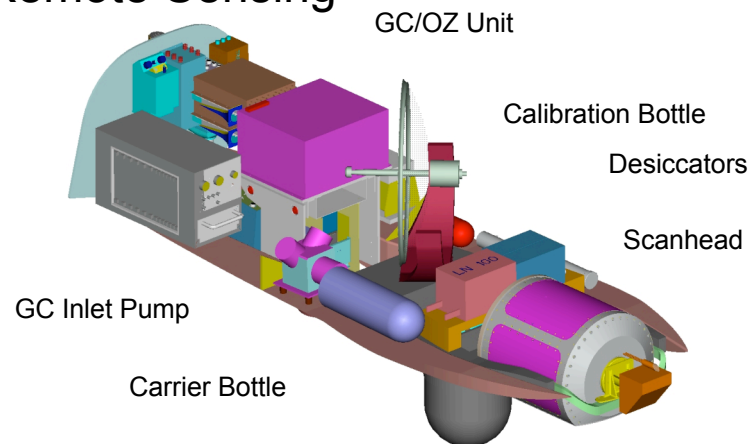




# 2005 NOAA/NASA Science Demonstration Flights



## Atmospheric Science Remote Sensing





## 2006 Esperanza Fire Emergency

First use of emergency  
COA process for  
civilian emergency

FAA indicates  
willingness to issue  
COA amendment  
within one hour of  
request & issues COA  
within 11 hours

~16 hr mission  
delivered near real-  
time imagery to fire  
incident command





# 2007 Fire Missions

Provided near real-time imagery to incident commands

8 Flights lasting up to 20 hours and imaging up to 10 wildfires per flight

One-hour loiters over fires

Excellent coordination with ATC

